REMARKS

The application contains claims 1-57. Claims 1, 6-8, 10, 19, 23-25, 30-34, 41-43, 45-47, 50-55 and 57 have been amended. In view of the foregoing amendments and following remarks, Applicants respectfully request allowance of the application.

At the outset, Applicants thank the Examiner for the thorough analysis of his 46 page office action. The Office Action contains several helpful suggestions to facilitate prosecution of the application and many have been adopted.

THE CLAIM OBJECTIONS AND INDEFINITENESS REJECTIONS ARE OVERCOME

The foregoing amendments have adopted the amendments suggested by the Office Action in paragraph 3, with respect to claims 10, 31-34, 41-43, 45-47, and 50-55. Claims 6-8, 19 and 54-55 have also been amended to address antecedent basis issues identified in paragraph 7 of the Office Action. Claims 23 and 24 are amended to correct minor typographical errors.

THE CLAIMS DEFINE STATUTORY SUBJECT MATTER

Claims 1-28, 30-39 and 57 stand rejected as failing to define statutory subject matter. Independent claims 1, 10, 19, 25, 30 and 57 are amended to clearly define an invention having utility within the technological arts. Accordingly, Applicants respectfully request withdrawal of all outstanding § 101 rejections.

SECTION 112, FIRST PARAGRAPH REJECTIONS

Claims 29-52, 56 and 57 stand rejected as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. Specifically, the Examiner alleges that the specification does not describe the method of identifying the captured symbols that have been or are likely to have been corrupted least by intersymbol interference or channel effects.

Paragraph 21 of the specification states that "[a]lthough the ISI effects associated with high-order symbol constellation transmissions impose large signal corruption on average, some samples suffer relatively low levels of ISI." Further, paragraph 21 states that "[t]hese samples are reliable samples" and that "[e]mbodiments of the present invention identify reliable symbols from a sequence of captured signal samples at a destination."

Paragraph 24 of the specification, for example, shows that the identification of a sample y_n as reliable may be carried out using a reliability factor R_n as given by Equation 3. The right hand side of Equation 3 is a summation operation based on the values of samples adjacent to a currently examined or evaluated symbol. The value of the current sample is not included in the summation operation. Rather, only the values of adjacent samples are used since the values of the adjacent samples model the ISI effects (e.g., data correlated noise or channel effects) associated with the given sample. Accordingly, the summation operation determines or is an estimate of the total ISI effects experienced by the given sample. This provides a method to designate the given sample as reliable if the "reliability factor of a sample y_n is less than a predetermined limit."

Paragraph 29 of the specification describes the effect of setting the predetermined threshold. As noted in paragraph 29:

> If the predetermined threshold is increased, then an increased number of samples will be accepted as reliable symbols though, of course, all of these symbols will not be of the same reliability. Similarly, by decreasing the threshold dlim, the number of samples that are designated as reliable symbols will decrease.

Clearly, the predetermined threshold specifies a level of estimated ISI corruption. Those samples having reliability factors that are less than the predetermined threshold are therefore the samples of a signal that are corrupted least by ISI/channel effects. Applicants therefore contend that the subject matter contained in claims 29-52, 56 and 57 is clearly described, either expressly or implicitly, in the specification in such a way as to reasonably convey to one skilled in the art that the inventor, at the time the application was filed, had possession of the claimed invention. Accordingly, Applicants request the Examiner to reconsider and withdrawal the rejections of claims 29-52, 56 and 57.

RESPONSE TO EXAMINER'S RESPONSE TO ARGUMENTS

On page 41 of the Office Action, the Examiner alleges that designating a captured sample "as a reliable sample is [the] same as designating the captured symbol as having an associated error probability less than a predetermined threshold." Applicants disagree with this characterization and contend the Examiner is conflating the identification of symbols likely to have been corrupted least by ISI with the identification of symbols having error probabilities less than a predetermined threshold.

As discussed above, identification of a reliable symbols is based on the determination of a reliability factor for a captured symbol. The reliability factor is a measure of the disruptive ISI effects experienced by a given captured sample. Those samples with low reliability factors are estimated to be less corrupted by ISI than those samples having a high reliability factor. While a low reliability factor indicates that a given sample is corrupted by a low amount of ISI, a low reliability factor does not ensure that a given sample has an error probability that is less than a predetermined threshold. Specifically, the methods described in the present application for identifying a reliable sample do not take into account the value of the evaluated sample itself. As is well known in the art, the value of the current sample is required to determine an error probability of the sample. Accordingly, the calculation of the reliability factor should not be construed as an error probability calculation, a prerequisite for comparison to a predetermined threshold.

THE PRIOR ART REJECTIONS

Summary of cited references

Hassan (U.S.P. 5,901,185)

Hassan discloses the generation of "information symbol estimates based on an iteratively generated transfer characteristic estimate," as illustrated in FIG. 10 (col. 9, lines 55-57). As shown in FIG. 10, a "first estimate of the transfer function is generated from . . . the predetermined pilot symbol symbols" (col. 9, lines 58-60). A first group of information symbols is then estimated "based on the first estimate of the transfer characteristic" (col. 9, line 66). A subsequent "estimate [of the transfer characteristic] is then generated from the pilot symbol

data, the information symbol data and the [first] information symbol estimates" (col. 10, lines 3-5). In this way, "information symbol estimates are generated using an iterative estimation of the transfer characteristic, in which each succeeding estimate . . . is augmented by previous estimates of the of information symbols" (col. 10, lines 10-14).

Each subsequent estimate of the transfer characteristic incorporates additional information symbol data to improve upon the previous estimate. The information symbol data included in a subsequent estimate generally includes "information symbol data corresponding to information symbols for which information symbol estimates, based on the current transfer characteristic estimate, have an associated bit error probability less than a predetermined threshold" (col. 10, lines 48-53). That is, information symbol data is included if an estimate of the information symbol based on the current estimate of the transfer characteristic has a low bit error probability. Accordingly, Hassan calculates the bit error probability of an estimated symbol from a current transfer characteristic estimate to determine if the corresponding symbol data is to be included in an updated estimate of the transfer characteristic.

Dent (U.S.P. 6,347,125)

Dent discloses a decoder using maximum likelihood sequence estimation (MLSE) based on the Viterbi decoding algorithm to determine the best estimate of a sequence of symbols in terms of minimizing the probability of decoding error. Dent, at col. 4, lines 31-41, describes how received symbols are modeled as complex vector values. The MLSE decoding operations performed on these complex vector values after demodulation are described at col. 4, lines 45-53:

> MLSE hypothesizes ***sequences of symbol values*** and combines them using the channel coefficients as weighting factors to attempt to predict the received samples. A cumulative metric is computed for each hypothesized sequence as ***the sum of the squares of the errors between predicted and actual signal samples***, and the sequence giving the lowest error is retained as the best decoded symbol sequence.

Accordingly, the mathematics alluded to in Dent, and based on the well know Viterbi algorithm, do not teach the summation of neighboring sample positions to determine a 'reliability factor' for a single captured sample.

Komatsu (U.S.P. 6,560,272)

Komatsu discloses a decode circuit including "an amplitude and phase estimation unit which estimates the amplitude and phase in transmission lines . . . a reliability measurement unit for calculating a reliability value of the estimated amplitude and phase . . . and an interpolation unit for compensating the phase of information symbols by deciding a method of interpolation on the basis of reliability" (col. 2, lines 57-66). The amplitude and phase estimation unit generates a transmission line estimation value for each received symbol. If the reliability of the transmission line estimation value exceeds a threshold, then transmission line estimation value is used to estimate the transmission characteristics of transmission lines. If the reliability of the transmission line estimation value does not exceed a prescribed threshold, then the transmission line estimation value is not used to estimate the transmission characteristics of transmission lines. Accordingly, transmission line estimation values are determined for received symbols and then are either used or not used for generating a transmission line estimate. The received symbols are not evaluated based on neighboring symbols but are instead evaluated based on metrics drawn from the received symbols themselves.

Agazzi et al. (U.S.P. 5,889,823)

Agazzi et al. discloses a concatenated decoding scheme implemented by an inner decoder and an outer decoder. A symbol-by-symbol detector generates a sequence of detected symbols based on a received signal. The inner decoder "is an N-best Viterbi decoder" that "releases a list of N paths ordered from most likely to least likely" (col. 7, line 49-53). The N paths generated by the inner decoder are each a sequence of decoded symbols based on the single sequence of detected symbols produced by the symbol-by-symbol detector. The N paths are generated using maximum likelihood sequence detection which minimizes error in decoding a ***sequence*** of detected symbols. The outer decoder "computes metrics for each path based on information about the received signal" (col. 5, lines 8-9). The path "having the best metric, i.e., the least error of the N paths, is selected as the output of the concatenated decoder [(i.e., as the mostly likely sequence of decoded symbols)]" (col. 5, lines 10-12).

Neither the symbol-by-symbol detector, the inner decoder nor the outer decoder identifies or detects 'reliable symbols' from a given sequence of received symbols. Rather, the inner decoder described by Agazzi at al. generates the N most likely sequences of symbols that were transmitted by an associated communication system. None of the constituent components described by Agazzi et al. are used to identify which received symbols are corrupted least by ISI/channel effects. Further, contrary to the assertion made by the Examiner, none of the constituent components described by Agazzi et al. are used to identify which received symbols have individual error rates/probabilities within a prespecified limit. Further, neither the symbol-by-symbol detector, the inner decoder nor the outer decoder use 'reliable symbols' to generate ISI metrics.

Isaksson et al. (U.S.P. 6,438,174)

Isaksson et al. discloses a multi-carrier transmission system. The system uses orthogonal carriers with high order constellations (e.g., QAM) for the transmission of multiple bits per symbol. Isaksson et al. does not disclose the identification of reliable symbols from captured symbols, the reliable symbols being those captured symbols that are estimated to be corrupted least by intersymbol interference.

Claims 1-9 and 53-55 Define Over the Cited Art.

Claims 1 and 53 are not anticipated by Hassan.

Claims 1 and 53 stand rejected as anticipated by Hassan, U.S.P. 5,901,185. Applicants respectfully request withdrawal of the rejections because Hassan does not teach or suggest all elements of the pending claims. Claims 1 and 53, for example, recite:

> **Claim 1**: calculating a ***reliability factor*** of a captured sample ***from values of a plurality of samples in proximity to the captured sample***,
>
> **Claim 53**: calculate a ***reliability factor*** of a captured sample ***from values of a plurality of samples proximate to the captured sample***,

Hassan does not teach or suggests this subject matter. As summarized above, Hassan discloses the inclusion of information symbol data for generating a new estimate of a transfer characteristic. The information symbol data is used if an estimate of the corresponding information symbol, as determined by the current estimate of the transfer characteristic, has a

low bit error probability. This requires Hassan to determine the bit error probability of an estimate of an information symbol from a current estimate of a iteratively updated transfer function. Accordingly, Hassan does not calculate a reliability factor as that term is defined in the specification of the present invention. Further, Hassan does not teach calculating a reliability factor from values of samples in proximity to a captured sample but instead teaches calculating a bit error probability of an estimated symbol from an estimated transfer characteristic. Applicants therefore respectfully submit that claims 1 and 53 define over the cited art and the rejections should be withdrawn.

Claims 2-9 depend, either directly or indirectly, from independent claim 1 and are allowable for at least the reasons applicable to claim 1, as well as due to the features recited therein.

Claims 54 and 55 depend from independent claim 53 and are allowable for at least the reasons applicable to claim 53, as well as due to the features recited therein.

Claims 10-18 Define Over the Cited Art.

Claim 10 is not obvious over Hassan and Dent.

Claim 10 stands rejected over Hassan and Dent, U.S.P. 6,347,125. Applicants respectfully request withdrawal of this rejection. The mathematics recited in claim 10 refer to the summation of neighboring sample positions (y_{n-i}) in a data stream to determine a reliability factor. The calculation is permitted to terminate early should the threshold be exceeded prior to exhausting the range of neighboring sample positions.

The Examiner alleges that Hassan iteratively determines a reliability factor for captured samples. On the contrary, as discussed above, Hassan determines the bit error probability of an estimated information symbol from a current estimate of an iteratively updated transfer function. Accordingly, Hassan does not calculate a reliability factor as that term is defined in the specification of the present invention. Further, Hassan does not teach iteratively calculating a reliability factor from values of samples in proximity to a captured sample but instead teaches calculating a bit error probability from an estimated transfer characteristic.

The Examiner alleges that Dent teaches adding values of samples y_{n-1} to a reliability factor. Applicants respectfully disagree. As discussed in the above summary, Dent discloses a decoder using maximum likelihood sequence estimation (MLSE) based on the Viterbi decoding algorithm to determine the best estimate of a sequence of symbols in terms of minimizing decoding error. Dent, at col. 4, line 30-41, describes a common technique for modeling received symbols as complex vector values. This modeling technique does not cure the deficiencies of Hassan. Further, the operations Dent performs on these complex vector values have no similarity to the mathematics recited in claims 10. The operations described by Dent are related to MLSE as described at col. 4, lines 45-53:

> MLSE hypothesizes sequences of symbol values and combines them using the channel coefficients as weighting factors to attempt to predict the received samples. ***A cumulative metric is computed for each hypothesized sequence as the sum of the squares of the errors between predicted and actual signal samples***, and the sequence giving the lowest error is retained as the best decoded symbol sequence.

Applicants accordingly see no similarity between Dent's system and the claimed invention. The mathematics alluded to in Dent do not teach the summation of neighboring sample positions to determine a reliability factor for a single captured sample. Examiner has therefore failed to show how the operations described in claim 10 are found in the cited art.

Claims 11-18 depend from independent claim 10 and are allowable for at least the reasons applicable to claim 10, as well as due to the features recited therein.

Claims 19-28 Define Over the Cited Art.

Claims 19 and 25 are not anticipated by Komatsu.

Claim 19 stands rejected as anticipated by Komatsu, U.S.P. 6,560,272. Claim 19 describes a method of determining reliability that represents a shortcut over the methods of claim 1 or claim 10. In this scheme, when determining whether a captured sample (say, y_n) is reliable, the method compares the value of neighboring samples (y_{n-i}) to a predetermined threshold. If one of the neighboring samples (y_{n-i}) exceeds the threshold, then sample y_n cannot be reliable.

As discussed in the above summary, Komatsu teaches the use of a transmission line estimation value when the reliability of the transmission line estimation value exceeds a prescribed threshold. A current transmission line estimation value is based on a current received symbol. The reliability of the transmission line estimation value is not based on neighboring symbols. Accordingly, Komatsu does not teach "designating [a] captured symbol as a reliable symbol" based on "whether any of the plurality of neighboring sample values is within a predetermined limit" as recited in claim 19. Applicants therefore request that the rejection of claim 19 be reconsidered and withdrawn.

Claims 20-24 depend, either directly or indirectly, from independent claim 19 and are allowable for at least the reasons applicable to claim 19, as well as due to the features recited therein.

Claim 25 also represents a shortcut method when compared to the structure of claim 1 or 10. In claim 25, a sequence of signal values having values within a predetermined limit is identified. A sample adjacent to this sequence is identified as a reliable symbol. As discussed above, Komatsu contemplates designating transmission line estimation values as reliable or unreliable. Reliability is determined independently of the reliability of neighboring transmission line estimation values. Overall, Komatsu does not address determining the reliability of a 'captured symbol.' Therefore, Komatsu does not teach "designating a sample adjacent to a sequence of signal values having values within a predetermined limit as a reliable symbol" as recited in claim 25. Applicants therefore request that the rejection of claim 25 be reconsidered and withdrawn.

Claims 26-28 depend, either directly or indirectly, from independent claim 25 and are allowable for at least the reasons applicable to claim 25, as well as due to the features recited therein.

Claims 29-43 and 56-57 Define Over the Cited Art.

Claims 29, 30, 40, 56 and 57 are not anticipated by Agazzi et al.

Claims 29, 30, 40, 56 and 57 stand rejected as anticipated by Agazzi et al., U.S.P. 5,889,823. Applicants respectfully request withdrawal of these rejections. As discussed above,

Agazzi et al. uses a symbol-by-symbol detector to generate a sequence of detected symbols from a received signal, an inner Viterbi decoder to generate the N most likely paths (i.e., decoded sequences) based on the sequence of detected symbols and an outer decoder to select the best path based on metrics generated for each path. The N paths are generated using maximum likelihood sequence detection which minimizes the probability of decoding error over a sequence of detected symbols. That is, the detected symbols are evaluated as a sequence and not individually according to a threshold requirement. Further, the detected symbols are not individually evaluated by only examining adjacent detected symbols. Accordingly, Agazzi et al. does not disclose "a reliable symbol detector to detect reliable symbols" where the reliable symbols are those "captured symbols which are estimated to have been corrupted least by ISI" as recited by claim 29. Additionally, Agazzi et al. does not disclose "an adaptation unit . . . to generate ISI metrics based on the reliable symbols." Accordingly, Applicants request that the rejection of claim 29 be reconsidered and withdrawn.

Claims 30, 40, 56 and 57 recite limitations similar to those recited in claim 29. As noted above, Agazzi et al. does not disclose any process through which a detector estimates which samples have been corrupted least by channel effects and then estimates the channel effects based on these identified samples. Accordingly, claims 30, 40, 56 and 57 are allowable in light of the reasons discussed above in regards to claim 29.

Claims 31-39 depend, either directly or indirectly, from independent claim 30 and are allowable are allowable for at least the reasons applicable to claim 30, as well as due to the features recited therein.

Claims 41-43 depend, either directly or indirectly, from independent claim 40 and are allowable are allowable for at least the reasons applicable to claim 40, as well as due to the features recited therein.

Claims 44-48 Define Over the Cited Art.

Claim 44 is not obvious over Hassan and Agazzi et al.

Claim 44 stands rejected over Hassan and Agazzi et al. Applicants respectfully request withdrawal of this rejection. The Examiner admits that Hassan does not teach "a reliable

symbol detector in communication with the buffer memory to identify which of the stored captured samples are likely to have been corrupted least by channel effects [(i.e., reliable symbols)]" nor "an adaptation unit in communication with the reliable symbol detector to estimate channel effects from values of the reliable symbols" as recited by claim 44. Applicants contend that Agazzi et al. does not cure the deficiency of Hassan. Specifically, as discussed above, Agazzi et al. uses a concatenated decoder to generated the N most likely sequences of decoded symbols based on the Viterbi algorithm. These N most likely sequences are not symbols identified as being likely to be corrupted least by channel effects. More broadly, the detected symbols are not evaluated in any manner nor compared to a threshold on any individual basis. Rather, the symbols comprising each sequence are those symbols that collectively minimize an overall probability of decoding error. Accordingly, Applicants request that the rejection of claim 44 be reconsidered and withdrawn.

Claims 45-48 depend, either directly or indirectly, from independent claim 44 and are allowable are allowable for at least the reasons applicable to claim 44, as well as due to the features recited therein.

Claims 49-52 Define Over the Cited Art

Claim 49 defines over Hassan, Isaksson et al. and Agazzi et al.

Claim 49 recites:

> identifying reliable symbols from the captured samples, ***reliable symbols being those captured samples that are estimated to be corrupted least by intersymbol interference,***
>
> calculating channel effects based on the reliable symbols and samples proximate thereto,

None of the cited art teaches or suggests this subject matter. As noted above, neither Hassan nor Agazzi et al. discloses the identification of 'reliable symbols' from captured symbols as this term is used in the present application. Although Isaksson et al. discloses use of multiple constellations, his disclosure does not cure the deficiencies of either Hassan or Agazzi. Claim 49, therefore, defines over this art.

Claims 50-52 depend, either directly or indirectly, from independent claim 49 and are allowable are allowable for at least the reasons applicable to claim 49, as well as due to the features recited therein.

CONCLUSION

Applicants respectfully submit that all claims are allowable over the cited art. Allowance is solicited.

The Office is hereby authorized to charge any additional fees or credit any overpayments under 37 C.F.R. 1.16 or 1.17 to Kenyon & Kenyon Deposit Account No. 11-0600. The Examiner is invited to contact the undersigned at (202) 220-4235 to discuss any matter concerning this application.

Respectfully submitted,

Wesley W. Jones (Reg. No. 56,552)

for Robert L. Hails, Jr.
Registration No. 39,702

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KENYON & KENYON
1500 K Street, N.W.
Washington, D.C. 20005
Ph.: (202) 220-4200
Fax.: (202) 220-4201